PATENT SPECIFICATION
DRAWINGS ATTACHED
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COMPLETE SPECIFICATION

Improvements in or relating to the Coating of Paper and the like

We, ENGLISH CLAYS LOVERING POCHIN & COMPANY LIMITED, a British Company, of 14, High Cross Street, St. Austell, Cornwall, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to apparatus for, and a method of, coating paper and like fibrous sheet materials.

It is known to apply coatings to paper and similar sheet materials for a number of purposes, for example to increase the gloss, smoothness, opacity and brightness of the material, or to hide surface irregularities thereof, and in particular to improve the surface of the material so that it is capable of taking print in the best possible manner.

Such coatings generally consist of pigment bound with an adhesive. The pigment which is used is principally kaolin or china clay, but alternatively others are used such as calcium carbonate, calcium silicate, satin white, and titanium dioxide. The adhesive may be a natural protein such as casein or soya, animal glue, starch, or a synthetic adhesive such as styrene butadiene, acrylonitrile or polyvinyl acetate. These pigments and adhesives may be used as desired in a number of combinations, and other additives may also be employed in the coatings. The coatings may be applied in one or more layers.

The apparatus presently used for applying the coatings are of relatively high capital cost. Furthermore they are costly to operate during the initial starting-up period during which the working of the apparatus is investigated to ascertain the optimum conditions for operation using any particular machine, sheet material, and coating composition. In a similar manner, the apparatus is expensive to operate for the purpose of obtaining experimental data when designing new apparatus.

Hitherto, for experimental purposes, a small apparatus has been used, this apparatus being essentially a scaled-down version of production apparatus. Such a scaled-down apparatus may have disadvantages, especially with regard to interpretation of results obtained therewith. In production apparatus, a blade is often used to spread the coating composition, and such blade coating machines operate at high speed. A web of paper or the like sheet material may be run through the machine at a speed of between 1500 and 3000 feet per minute, and such high speeds are difficult to attain in a scaled-down apparatus. Since the performance of a blade coating machine is dependant partially upon the speed at which the machine is run, the results obtained with a scaled-down apparatus may not be reliable. On the other hand, if full-size or scaled-down conventional apparatus is run at a high speed, relatively large quantities of sheet material and coating composition are necessary for a test, with the additional, consequential, problem that a large quantity of coated sheet material needs to be dried before laboratory testing. Laboratory testing is, however, generally carried out on small samples of material so that much wastage may occur.

It is an object of the invention to provide apparatus and a method for the experimental coating of paper and like sheet materials for test purposes under conditions closely resembing those which prevail during the coating of sheet materials on a large scale.

According to one aspect of the present invention, there is provided apparatus for coating sheet material, the apparatus comprising a rotatable backing roll upon which a sample

[*Price 4s. 6d.*]

of sheet material may be mounted to form a cylinder, a coating head including a blade and a reservoir for reception of coating composition, and means for enabling the coating head to be moved in operation parallel to the axis of rotation of the backing roll and in contact with the sheet material mounted thereon whilst the backing roll is rotated, whereby a helical strip of sheet material may be coated.

According to another aspect of the present invention, there is provided a method of coating sheet material, the method comprising rotating the sheet material in the form of a cylinder about the axis of the cylinder and applying a coating to the sheet material by a coating head loaded with coating composition, the head being moved parallel to the axis of the cylinder whilst the latter is rotated, thereby applying the coating composition to a helical strip portion of the cylinder of sheet material.

For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made by way of example to the accompanying drawings in which:—

Figure 1 shows a general perspective view of apparatus for coating sheet material,

Figure 2 is a perspective view of part of the apparatus, and

Figure 3 is a diagrammatic elevation illustrating the operation of the apparatus.

The apparatus shown in Figure 1 comprises a frame 1 upon which are mounted two aligned bearing blocks 2, only one of which may be seen in Figure 1. An axle 3 for a rubber-covered backing roll 4 is mounted for rotation in the bearing blocks 2. The backing roll 4 may be driven in the direction indicated by arrow R by an electric motor 5 through variable speed gearing 6, pulleys and a belt 7. A carriagway comprising two parallel bars 8 is mounted on the frame 1 so as to extend parallel to the horizontal axis of the axle 3 and at a level slightly below such axis.

Movably mounted by way of bobbin-shaped roller 9 on the bars 8 is a coating head indicated generally at 10. The coating head 10 is movable along the carriageway with the aid of a hydraulic cylinder 11 and ram 12, the cylinder 11 being mounted on the frame through the intermediary of a bracket 11*a*. Power for the hydraulic cylinder and ram may be supplied from a hydraulic pump 13 mounted on the base of the frame 1 of the apparatus. Passage of hydraulic fluid from the pump 13 to the cylinder 11 is by way of pipes (such as the pipe 11*b* in Figure 2) in known manner, and may be regulated by a control valve 14.

The construction and arrangement of the coating head 10 are more fully illustrated in Figure 2. A platform is carried by the rollers 9 and has mounted thereon two side pieces 16 between which carried a blade support 17. A curved blade 18 is clamped in known manner to the bottom of the blade support 17. The blade is of spring steel of 0.2 to 0.4 mm. thickness, and comprises essentially a very short portion of a conventional coating blade so that the vertical dimensions and configuration of the blade are conventional, whereas the width is greatly reduced. The backing roll 4 is also of conventional dimensions, and may be 2 feet (60 cm.) in diameter and 3 feet (90 cm.) in length, whereas the blade 18 is only 3 or 4 inches in length, say 3 to 4 inches (about 8 to 10 cm.). A coating chamber 19 is formed by the blade 18 and two extensions 16*a* to the side pieces 16, such extensions being curved to accommodate the adjacent arc of the backing roll 4. The inner walls of the coating chamber are electro-plated to resist chemical attack. The extensions 16*a* forming the sides of the chamber 19 are fitted with felt edge seals 20. The blade 18 may be adjusted on a slider 21 by a toggle arm 22 in a direction towards or away from the backing roll. Adjusting means (not shown) are also provided in known manner for carrying the angle of the blade 18 with respect to the surface of the backing roll 4, for varying the pressure of the blade on the backing roll, and for varying the vertical position of the blade with respect to the equator of the backing roll. A tray (not shown) is disposed below the backing roll and the coating head for receiving excess coating composition in operation.

For commencing operation, the coating head 10 is moved by conventional means away from the backing roll 4, and is then brought to one end of the backing roll. It will be assumed for the purpose of this description that the coating head 10 is brought to the left-hand end of the roll as seen in the Figures. A sample of the sheet material which is to be coated, and which may be of paper, for example, is wrapped around the backing roll 4 and held in position by adhesive tape. The sample has a width aproximately equal to the length of the backing roll 4, and the length of the sample is such that it may be wrapped completely around the backing roll, with or without a little overlap. Thus the sample of sheet material assumes the form of a circular cylinder. The backing roll 4 carrying the sample is rotated in the direction indicated by the arrow R with the coating head 10 retracted away from the surface of the backing roll until the latter has reached the desired speed of rotation. The peripheral speed of the backing roll and its sample may be equal to the linear speed of the web of paper or like sheet material in a full-scale coating apparatus. The coating head 10 is moved towards the sample of sheet material on the backing roll

and is adjusted as desired in respect of its position and its pressure on the sample.

When the various adjustments are complete, the appropriate coating composition is poured into the reservoir 19 and the coating head 10 is caused to traverse the backing roll 4 in the direction indicated by the arrow T by admitting hydraulic fluid to the cylinder 11 and thereby actuating the ram 12. At the end of the traverse of the coating head 10, the backing roll 4 is braked and the head 10 is removed from the surface of the sheet material on the stationary backing roll, thus dropping the unused coating composition into the tray (not shown) below the coating head 10. The speed of movement of the coating head 10 in the direction of the arrow T is controlled by the valve 14 in such a way as to produce a spiral path of coated paper on the sample, which path if desired may cover substantially the whole surface area of the sample. Thus, for a higher speed of rotation in the direction R, a higher speed of traverse in the direction T is required.

Figure 3 shows diagrammatically the product of complete traverse of the coating head 10, the coating head being shown in a position part way along the traverse.

The felt edge seals 20 produce markings indicated at 23 in Figure 3. At the left-hand end of Figure 3, there is shown in broken lines an edge marking 25*a* which has been erased during the traverse. This marking 23*a* is one of the edge markings of an initial coated hoop 24 produced during the initial running-up period of the roll after the coating composition has been introduced into the reservoir 19 but before the traverse has occurred. After the traverse has been initiated, a helical path 25 is produced extending the length of the cylinder of sheet material on the backing roll. A narrow gap 26 is left between each turn of the helix in the product shown, but this gap may be removed if desired by suitable adjustment of the control 14. At the end of the helical path, the coating head 10 is brought to a halt with the backing roll still rotating so as to produce a coated finishing hoop 27, thereby erasing the final part of the helical path. It will be seen that, apart from the ends of cylinder, the sheet material is coated with only one coat of composition and may be coated at a speed comparable with that of production apparatus without producing a large quantity of coated material. The helical path 25 is disposed at an angle A of only about $2\frac{1}{2}°$ to the direction of motion R of the sample of sheet material, so that the departures from truly linear coating is negligible. It is found in practice that there is no interference with the coating results, by virtue of the sideways movement of the coating head 10, if the length of the blade 18 is about one tenth of the length of the backing roll 4, as described above. However, if desired the blade 18 may be longer, being up to about one-quarter or one-third of the length of the backing roll 4, or may be even shorter than one-tenth of this length.

After the coating head 10 has been withdrawn from the sheet material, the latter is dried. This may be done either *in situ*, for example by radiant heat, or may be done by removing the sample from the backing roll and drying in a drying chamber, with for example hot air. Since only a small quantity of coating composition is used on each sample, relatively little expenditure of heat energy is involved in the drying process. After drying, the sample is cut into strips for examination.

It will be appreciated that a number of modifications may be made to the apparatus described above. For example, the carriageway may be replaced by a lathe carriage for the coating head 10. If desired, a mirror (not shown) may be disposed at a suitable angle above the coating head 10 so that an operator may be able to study the conditions prevailing within the reservoir 19. In this way the turbulence of the coating composition may be observed during operation.

WHAT WE CLAIM IS:—

1. Apparatus for coating sheet material, the apparatus comprising a rotatable backing roll upon which a sample of sheet material may be mounted to form a cylinder, a coating-head including a blade and a reservoir for reception of coating composition, and means for enabling the coating head to be moved in operation parallel to the axis of rotation of the backing roll and in contact with the sheet material mounted thereon whilst the backing roll is rotated, whereby a helical strip of sheet material may be coated.

2. Apparatus according to Claim 1, wherein the blade has the form of a short section of a conventional blade, the length of the blade being less than one-third of the length of the backing roll whereas dimensions other than that of length are substantially conventional.

3. Apparatus according to Claim 1 or 2, wherein the length of the blade is approximately one-tenth of the length of the backing roll.

4. Apparatus according to any preceding claim, wherein the blade is of spring steel.

5. Apparatus according to Claim 4, wherein the blade is from 0.2 to 0.4 mm. thick.

6. Apparatus according to any preceding claim, wherein the blade is held between substantially parallel plates, the planes of which are substantially vertical and substantially perpendicular to the axis of rotation of the backing roll, said axis of rotation being substantially horizontal, one edge of each plate being curved to correspond to the curved cylindrical surface of the backing roll, the

arrangement of the coating head being such that said curved edges may be brought into contact with the sheet material mounted on the backing roll, whereby said reservoir is formed in operation by the co-operation of said plates with the blade and with the sheet material mounted on the backing roll in the region between said plates.

7. Apparatus according to Claim 6, wherein said one edge of each plate is covered with a felt seal.

8. Apparatus according to any preceding claim, wherein the coating head is mounted on a carriageway extending parallel to the axis of rotation of the backing roll, and is connected to hydraulically operable means for moving the same along the carriageway.

9. Apparatus according to Claim 8, wherein the coating head is mounted on the carriageway through the intermediary of a slide which may be moved in a direction substantially perpendicular to the extent of the carriageway.

10. Apparatus according to any preceding claim, wherein the backing roll is arranged to be rotated, selectively, at different speeds, and wherein the means for moving the coating head is such that the coating head may be moved parallel to the axis of rotation of the backing roll, selectively, at different speeds.

11. Apparatus according to any preceding claim, wherein a mirror is mounted above the coating head in such a way that an operator may see the contents of the reservoir.

12. Apparatus for coating sheet material substantially as hereinbefore described, with reference to, and as illustrated in, the accompanying drawings.

13. Sheet material whenever coated by the apparatus according to any preceding claim.

14. A method of coating sheet material, the method comprising rotating the sheet material in the form of a cylinder about the axis of the cylinder and applying a coating to the sheet material by a coating head loaded with coating composition, the head being moved parallel to the axis of the cylinder whilst the latter is rotated, thereby applying the coating composition to a helical strip portion of the cylinder of sheet material.

15. A method according to Claim 14, wherein the coating head is moved parallel to the axis of the cylinder by hydraulic means.

16. A method according to Claim 14 or 15, wherein the coating head is moved parallel to the axis of the cylinder at such a speed in relation to the speed of rotation of the cylinder and to the width of said helical strip portion, that the whole of the cylinder is coated.

17. A method according to Claim 14 or 15, wherein the coating head is moved parallel to the axis of the cylinder at such a speed, in relation to the speed of rotation of the cylinder and to the width of said helical strip portion, that uncoated gaps are left between successive turns of said helical strip portion.

18. A method according to any one of Claims 14 to 17, wherein the cylinder is formed by wrapping the sheet material around a backing roll and securing with adhesive tape.

19. A method according to Claim 18, and further comprising drying the cylinder *in situ* on the backing roll.

20. A method according to Claim 18, and further comprising removing the sheet material from the backing roll and drying the sheet material.

21. A method of coating sheet material, substantially as hereinbefore described with reference to the accompanying drawings.

22. Sheet material whenever coated by the method according to any one of Claims 14 to 21.

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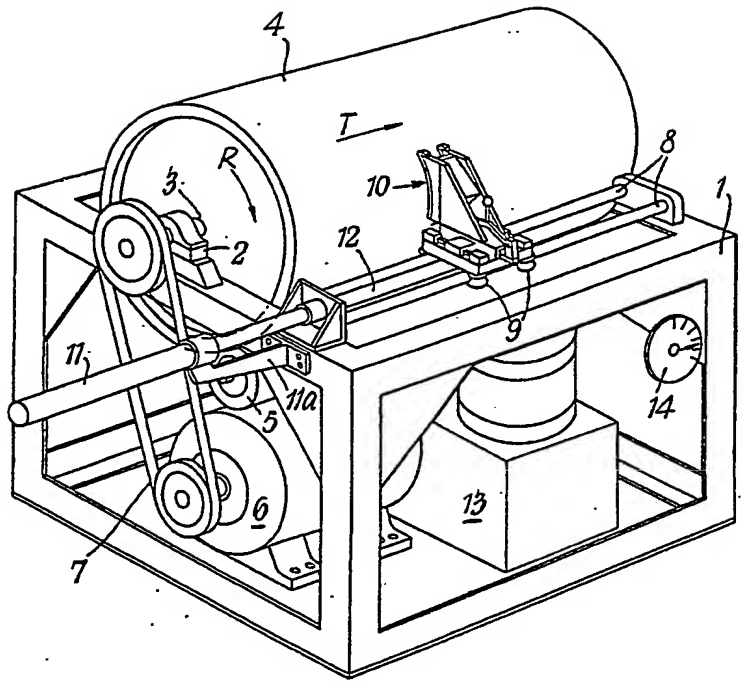

FIG.1

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Sheets 1 & 2

FIG.2

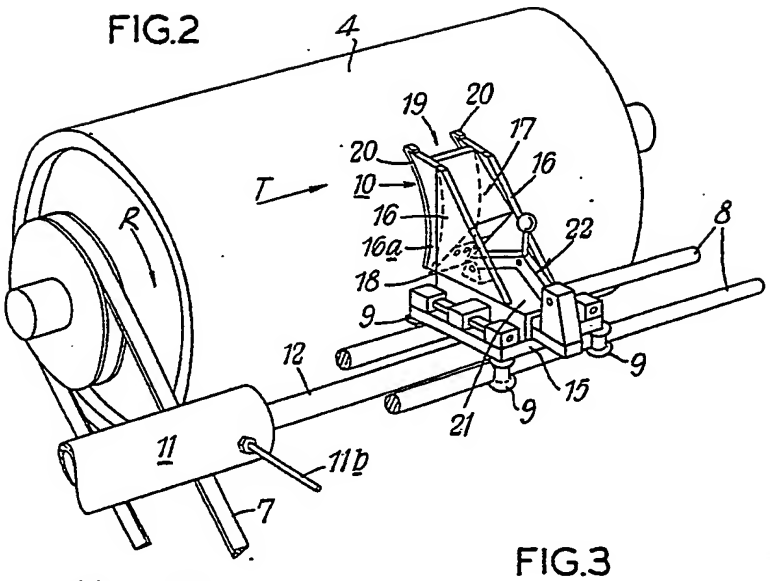
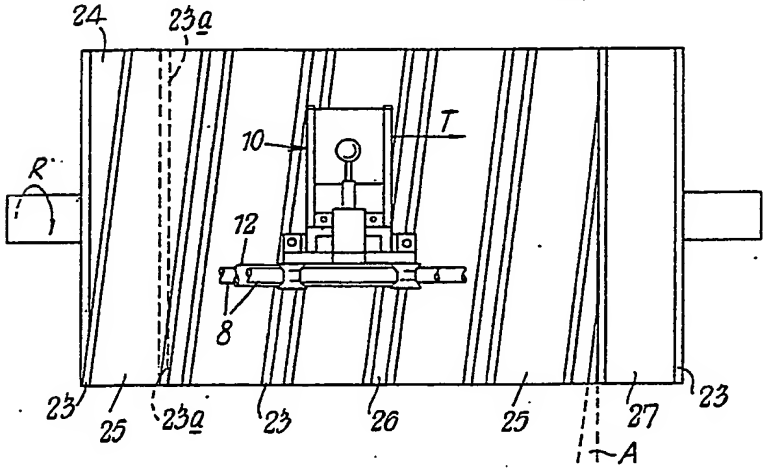


FIG.3



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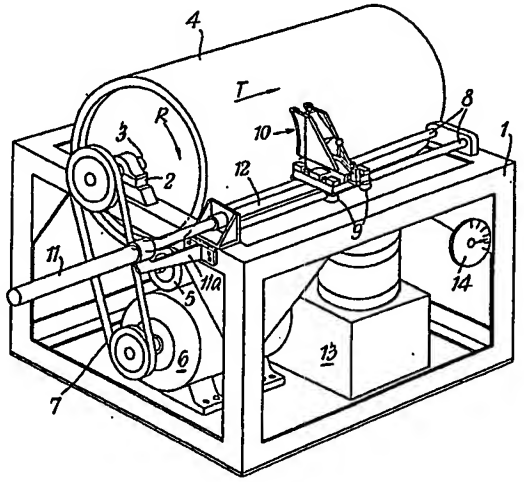

FIG.1

FIG.2

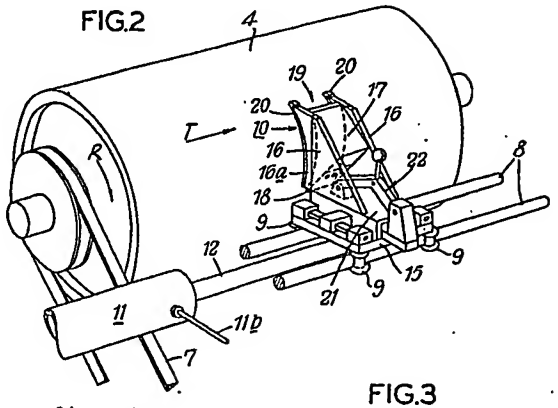

FIG.3